APPENDIX F

Preliminary Geologic Cross Sections

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PRELIMINARY GEOLOGIC CROSS SECTIONS

INTRODUCTION

Six preliminary geologic cross sections were constructed for the Kennecott hydrogeologic study at the locations shown on Plate F-1. The following discussion presents the guidelines and assumptions that were used to interpret the geologic information obtained from boring logs and in the construction of the sections and illustration of the various geologic features encountered within the study area. Also used were various sources of literature addressing the subsurface conditions and geology, including Bray and Wilson, 1975; Schlotthauer and others, 1981; Smith, 1961; Tooker and Roberts, 1971; Mattick, 1970; and Hely and others, 1971.

GEOLOGIC LOGS

GENERAL

Logs which were used to draw the six sections were obtained from several sources. Kennecott's Addendum I, Historical Borehole Geophysical Logs, Geologic Logs of Borings and Well Construction Data contain boring information for many of the wells installed in previous studies by Kennecott and also boring logs for many private wells. Well driller's reports obtained from the State Engineer for Township 3 South, Range 1 West provided a great deal of subsurface information for the South Jordan, West Jordan and Riverton Areas. Finally, Dames & Moore drilling for Kennecott during Phase I and II provided 49 borings with higher detail of the subsurface conditions, and allowed for better interpretation of and correlation with existing data.

LOG INTERPRETATION

Prior to construction of the sections, suitable classifications for geologic materials were needed to simplify and standardize all available data, so that subsurface data could be presented in a unified form and represented graphically. This form of categorizing rock and sediment types was also required for the great variety of logs, logging techniques and degrees of description assigned to materials encountered. Only logs to which material types could be assigned with any degree of certainty were used. We included in construction of the cross sections as much of the data as was practical to illustrate subsurface conditions.

MATERIAL CATEGORIES

To present the geological data in a simplified form which could be illustrated, material types were grouped together into eight general categories:

1. Gravel - Gravel (G) has been assigned to materials referred to in the logs as gravel, gravel and sand, gravel and cobbles, gravel and boulders, or any combination of these coarse sediments.

2. Silty Gravel - Silty gravel (SG) is assigned to gravels or gravels and sands which have been noted in the logs to be silty. Many of the gravels with a "G" designation likely fit into this category as well, but because "clean" sands and gravels exist in the study area, the gravel categories have been designated separately.

3. Sand - Sand (S) is assigned to those materials which were called out in the logs with sand being the primary component and no other material types mentioned.

4. Silty Sand - Silty sand (SIS) is assigned to materials containing primarily sand with varying amounts of silt.

5. Sandy Clay - Sandy clay (SC) is assigned to units referred to in the logs containing sandy clay, clayey sand, or interbedded units of sand and clay.

6. Clayey Gravel - Clayey gravel (CG) is assigned to materials containing clayey gravel, gravelly clay, gravel and clay, or interbedded units of clays and gravels.

7. Silt - Silt (SI) is assigned to materials referred to in the logs in which silt is the major component or the only material type mentioned.

8. Clay - Clay (C) is assigned to materials referred to in the logs as clay, silty clay, or interbedded silt and clay. The designations "SI" and "C" may be used together on some logs.

CONFINING UNITS

Confining units shown on the cross sections were interpreted in conjunction with the material categories used to simplify geological data. Generally, all fine-grained units were interpreted as confining, including clays, silts, silty clays, sandy clays, or clayey gravels. The stippled pattern on the cross sections has been used to illustrate the general thicknesses and extent of finer-grained sediments.

CONSTRUCTION OF CROSS SECTIONS

Guidelines were adopted prior to construction of the cross sections. A 10:1 vertical exaggeration scale was chosen to show topography as well as subsurface detail from boring logs. Generally, geologic units with less than 20 feet of thickness were not shown, with the exception of clays and confining units. Near the Jordan River in the eastern portion of the study area, coarser units become thinner and units of less than 20 feet in thickness became more important to illustrate, so these were considered.

Simplification of boring data into material categories involved grouping some materials, such as sands and clays or gravels and clays, into units. Because units or material types of less than 20 foot thickness were generally not shown, thinner interbedded materials were grouped into the adjacent material types both above and below to form one material category. This more or less involved weighted averaging of material thicknesses. Material categories, as previously defined, also allowed for grouping of interbedded units so as not to ignore the presence or significance of thinly bedded confining materials.

Boring logs were projected orthogonally to the lines of section and plotted at the observed or surveyed elevation. Boring P248C on Section A-A' was not projected in this way; it was, however, shown to display relationships with the volcanic rocks and coarse alluvium of Bingham Creek.

Borings used in constructing sections were generally less than 2,000 feet off the lines of a section. Many of the fluvial and alluvial materials tend to be discontinuous and cannot be extrapolated over long distances; hence, 2,000 feet was the maximum distance used. On occasion, borings greater than 2,000 feet off section were used where no borings fell within the cutoff limit and it became necessary to fill gaps with boring information from slightly greater distances off section.

Water levels on the sections have been interpolated from the Water Level Map, Figure 3 of the main text. On several of the sections, water levels are actual and have been indicated as such.

GEOLOGIC FEATURES

GENERAL

Several depositional features are represented in the logs, including lacustrine, alluvial, colluvial and fluvial sedimentation. Observations of the cuttings, drilling conditions and geophysical logs for borings drilled during Phases I and II indicate the presence of semiconsolidated to consolidated and cemented sediments at depth. This surface has been previously recognized and identified in the literature as the contact where unconsolidated Quaternary deposits overlie unconformably on a semiconsolidated to consolidated Tertiary surface (Arnow, Van Horn, LaPray, 1970). Arnow, et al. have determined that this surface is where hard layers greater than three feet are encountered, or where drilling became "hard" and was later followed by softer drilling in non-cemented sediments. Arnow speculates that a transition period between Tertiary and Quaternary time was marked by exposure of the Tertiary surface and formation of soil at the surface with calcium carbonate cementing agents.

Tertiary boundaries have also been recognized in other parts of the study area. Slentz (1955) identified members of the Salt Lake Group of Tertiary age as exposed at the Jordan Narrows where the Jordan River cuts through the Traverse Range. Slentz's Jordan Narrows Unit which consists of fresh water lacustrine deposits ranging from clays and marlstones to argillaceous and cherty limestones and sandstones, has been identified (Marine and Price, 1964) in borings W11 and W16 which are shown on Sections E-E' and F-F', respectively. Marine and Price state that the Jordan Narrows unit is usually reported as clay in the driller's logs.

SEMICONSOLIDATED AND CEMENTED SEDIMENTS

Borings drilled during Phases I and II have provided a great deal of information concerning the top of this semiconsolidated surface throughout the study area. Table B-6 in Appendix B estimates the Tertiary contacts which potentially correspond to the top of a semi-consolidated or cemented Tertiary boundary. Borings at sites P249, P250, P252 and P276 all demonstrate a strong presence of calcium carbonate cementing agents. Consolidation of sediments is readily apparent on the geophysical gamma-gamma density log for P241C (see Addendum, Appendix B), by increased counts. During the drilling of Phases I and II borings, consolidation was usually determined after the drillers encountered hard zones and could advance the boring without the use of temporary drive steel casing.

VOLCANIC SEDIMENTS

Gravels and sands derived almost entirely from volcanic sources were identified in borings at sites P266, P267, P268, P269 and P274. Contouring of the top of these gravels indicates a fan surface generated from the Rose and Butterfield Canyon areas dipping moderately to the east and northeast, but it is absent north of 11800 South and east of Highway 111. These gravels were derived from adjacent volcanic rocks of Tertiary age, and were later reburied by younger alluvial colluvial and lacustrine sediments. In boring P274, volcanic gravels were encountered at approximately 290 feet. Boring P274 was started in or nearly into Tertiary alluvium which is composed primarily of poorly sorted quartzite boulders gravels and sands assigned to the Harkers Fanglomerate (Slentz, 1955). The deep burial of these volcanic gravels beneath a younger thick wedge of Tertiary alluvium at site P274 indicates that these volcanic sediments are probably also Tertiary in age.

Salt Lake County Water Conservancy District borings W402 and W403 located just south of Herriman (see Figure 2, main text) penetrate through 450 to 550 feet of what has been described as a "volcanic fanglomerate." This unit has generally been described as angular clasts of andesite, latite, rhyolitic tuff, limestone and quartzite, unconsolidated. These borings demonstrate that the volcanic gravel sediments directly overlie interbedded mudstone, claystone, clay and conglomerate which were identified as the Jordan Narrows Unit.

CONSOLIDATED CLAYS

Clays of great thickness were encountered in borings P254B and P247B east of the old evaporation ponds, and these clays have been correlated with clays identified as the Jordan Narrows Unit in borings W11 and W16 (Marine and Price 1964) to the north and south of the evaporation ponds. These clays generally drilled very hard, occasionally presenting difficulty in driving casing. These clays and their interbedded sandy clays and gravels generally could be drilled without casing the boring. Similar clays or clayey units have also been identified in borings P256, P258B, P263 and, as mentioned before, in borings W402 and W403. For a list of these probable contact elevations, see Table B-6 in Appendix B.

QUATERNARY AND LAKE BONNEVILLE SEDIMENTS

Arnow states that Quaternary deposits reach their maximum thickness to the northwest of Salt Lake City, and thin rapidly in a southern direction. These deposits thin to 300 feet in the Murray area, and to 200 feet west of Kearns. The top thickness of Quaternary sediment consists primarily of Lake Bonneville deposits and younger alluvium attributed to stream and river deposits.

Lacustrine sediments associated with glacial Lake Bonneville are present in most Phase I and Phase II borings below the 5090 contour line, and range in thickness from 10 to 75 feet below ground surface where present. In the lower parts of the valley, particularly near the Jordan River, this top thickness of Bonneville sediments may thicken somewhat as evidenced by several boring logs describing blue clays at depths near 100 feet. These sediments are generally silty or clayey and are darker in color than the typical underlying yellowish brown sediments. These lacustrine sediments are shown as a confining unit veneering the surface where indicated by the logs on Sections C-C' and D-D', as well as to the west of the evaporation ponds on Sections E-E' and F-F'.

Blue clays and blue sandy clays which achieve great thicknesses near the Great Salt Lake likely correlate to the blue silty sands and clays observed in boring P258B with a thickness of 20 to 25 feet. Other borings in the vicinity of Section D-D' also mention up to a 30-foot thickness of blue clay, but because it was not specifically called out on many of the logs along this line of section it was not shown. The blue clays generally do not appear in any logs west of Redwood Road, in the South Jordan area.

CONCLUSIONS

The cross sections illustrate the general distribution of volcanic rocks in the Oquirrh foothills, the coarser sediments associated with alluvial deposits in the western half of the study area, and the finer-grained confining units generally found to the east of the old evaporation ponds. Additionally, the sections illustrate the relationship of water levels within these sediments. These sections show the presence of older semiconsolidated to cemented sediments which exist at depth and are possibly Tertiary in age. These sediments are expressed as volcanic gravel deposits, semiconsolidated to consolidated sediments and cemented sediments to the west and north of the old evaporation ponds. To the east and south of the old evaporation ponds, these semiconsolidated to consolidated deposits are represented by thick clay deposits which have been correlated to the Tertiary Jordan Narrows.

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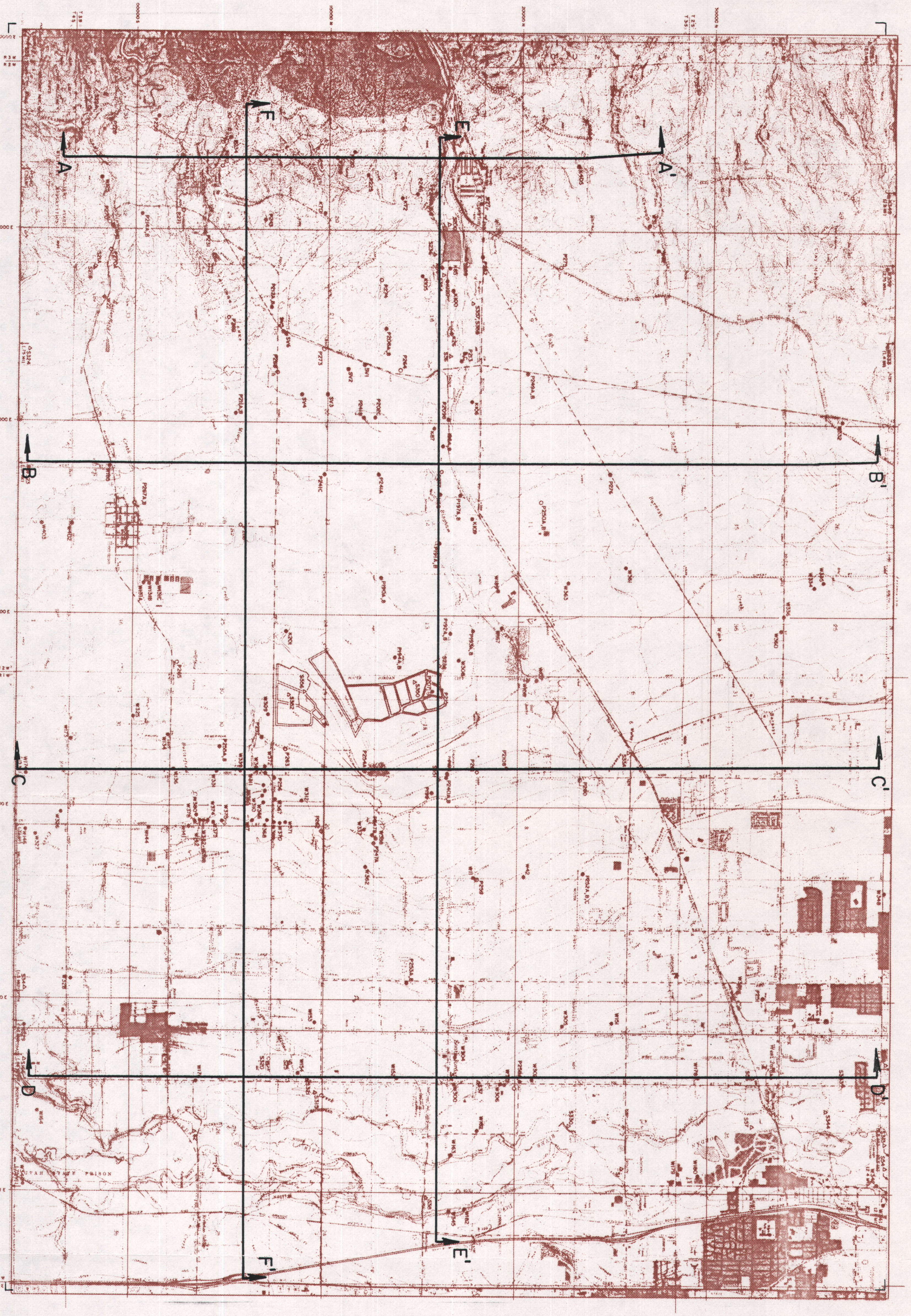
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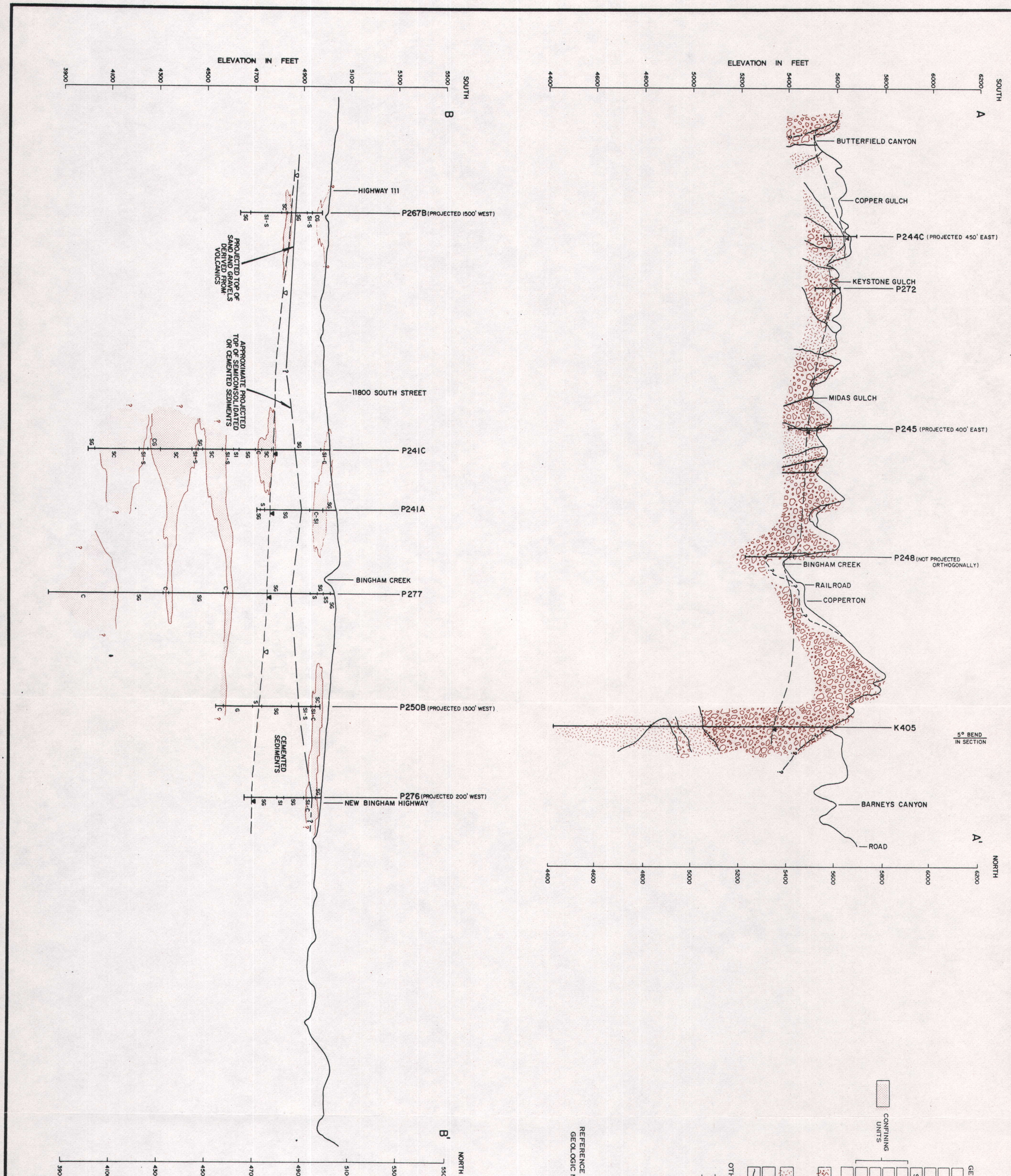

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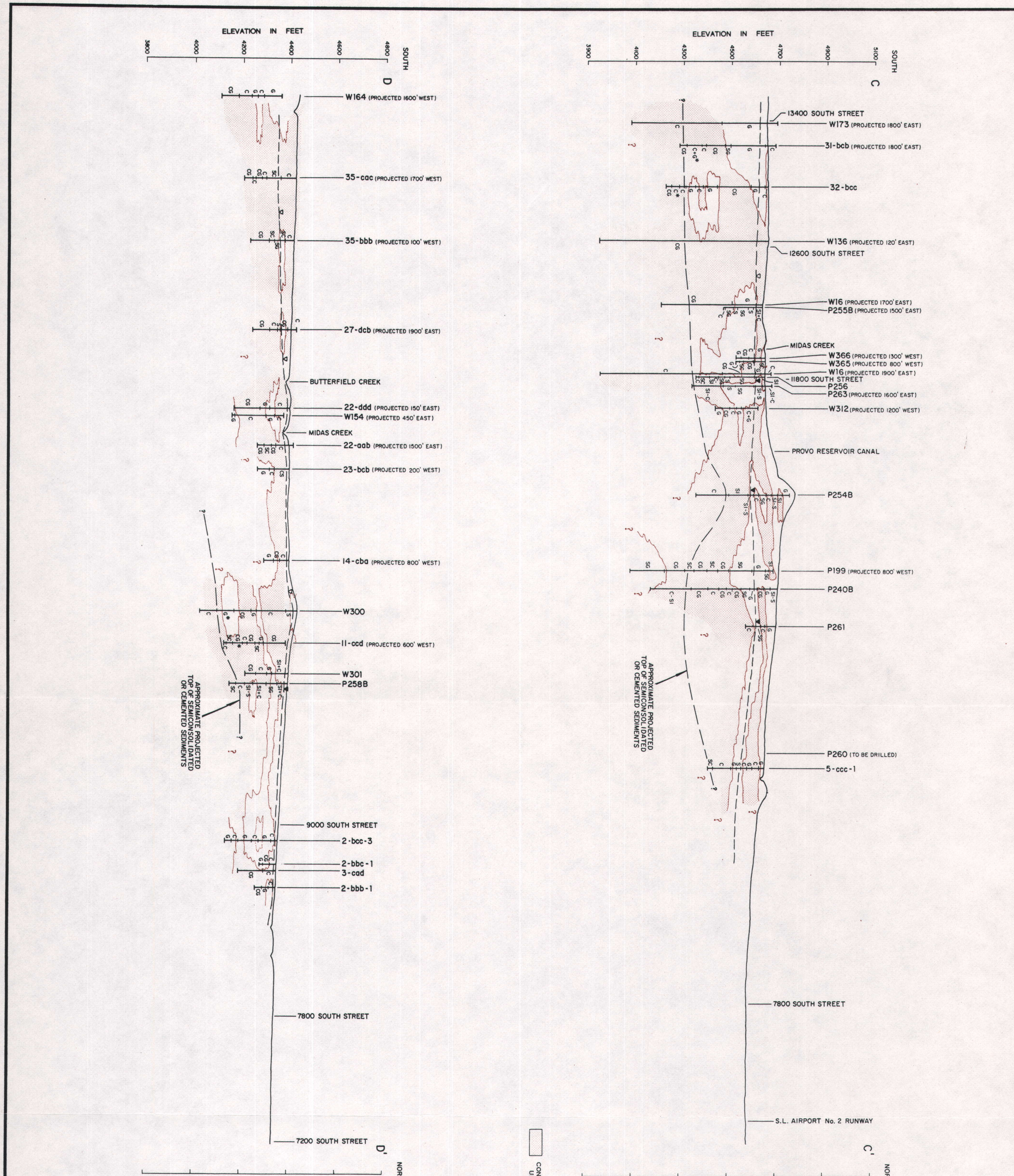

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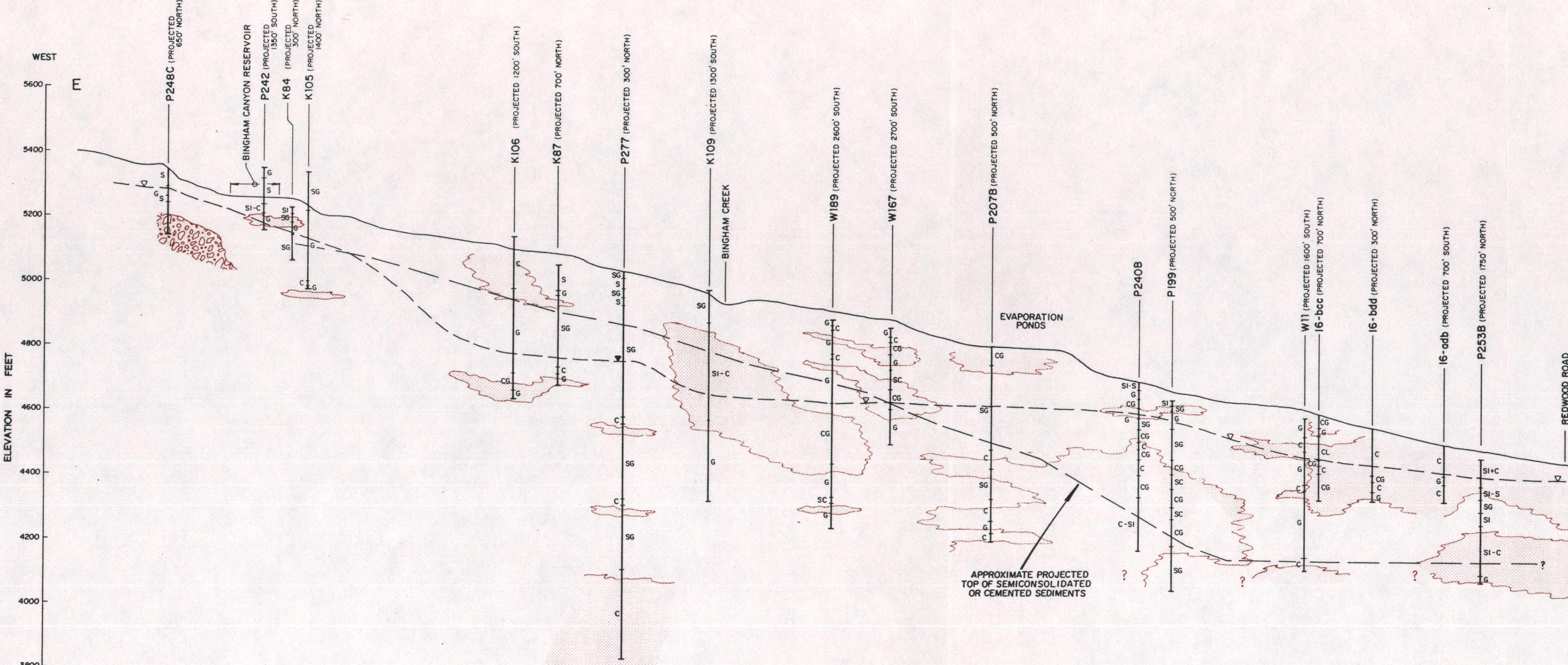

GEOLOGICAL MATERIALS

G	GRAVELS
SG	SILTY GRAVELS
S	SAND
SI-S	SILTY SAND
SI	SILT
CG	CLAYEY GRAVEL
SC	SANDY CLAY
C	CLAY
*	INDICATES CEMENTATION

CONFINING UNITS (SI, CG, SC, C)

VOLCANIC AGGLOMERATE — INCLUDES LATITE BRECCIA, ANDESITE BRECCIAS, AND AGGLOMERATES WITH INTERBEDDED TUFFS AND MUD FLOWS OF TERTIARY AGE

VOLCANIC FLOWS — INCLUDES LATITES, ANDESITES, DACITES, AND RHYOLITES

UNDIFFERENTIATED VOLCANIC DIKES

CONTACTS — DASHED WHERE QUERIED

OTHER SYMBOLS

▼ WATER LEVEL — MEASURED

▽ WATER LEVEL — INTERPOLATED FROM FIGURE 3, MAIN TEXT

HORIZONTAL SCALE IN FEET

2000 0 2000 4000

VERTICAL EXAGGERATION = 10x

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